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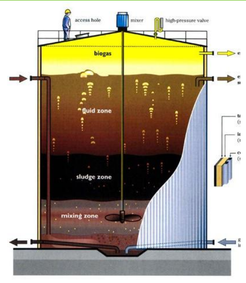
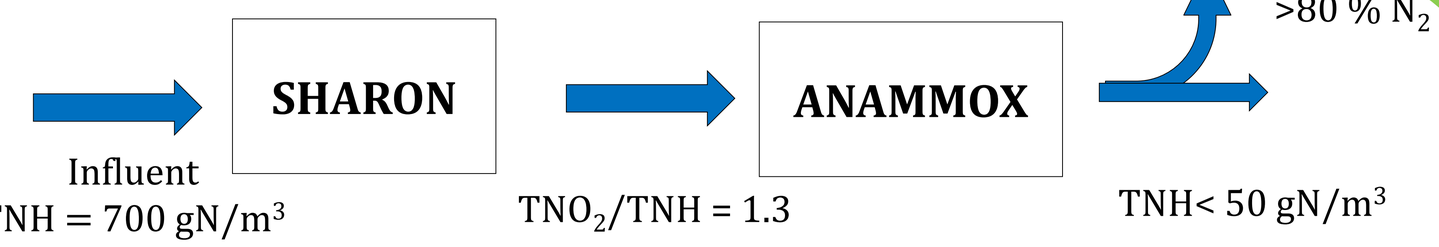
Introduction. Complete autotrophic nitrogen removal (CANR) by the SHARON-Anammox sequence depends critically on feeding the Anammox reactor with an appropriate relation of ammonium and nitrite. We incrementally design a control system, following a plantwide control methodology (Larsson *et al*. 2000) and based on an analysis of the disturbances and controlled variable selection.

Objectives



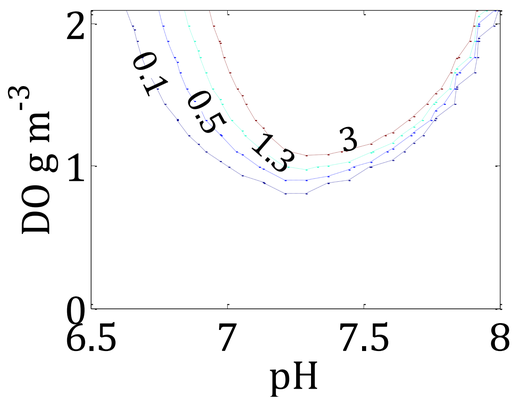
Anaerobic digester



Top-down analysis

- Optimisation of operating conditions

pH and DO → $TNO_2/TNH = 1.3$?

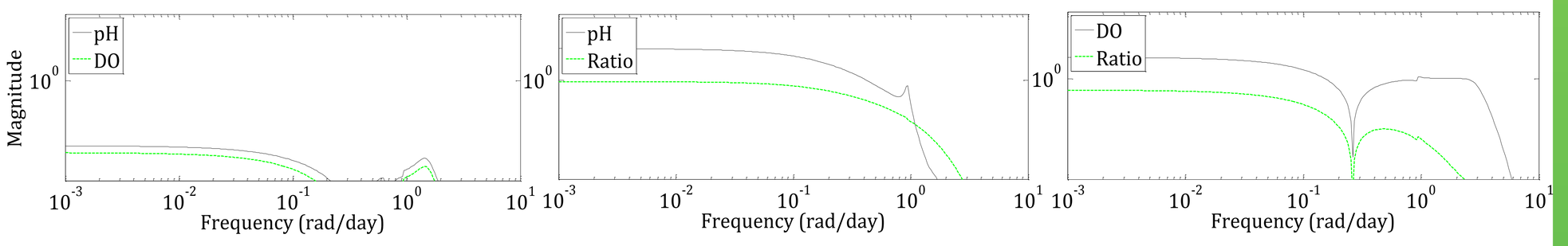


pH=7.23
DO=1.06 g m^{-3}

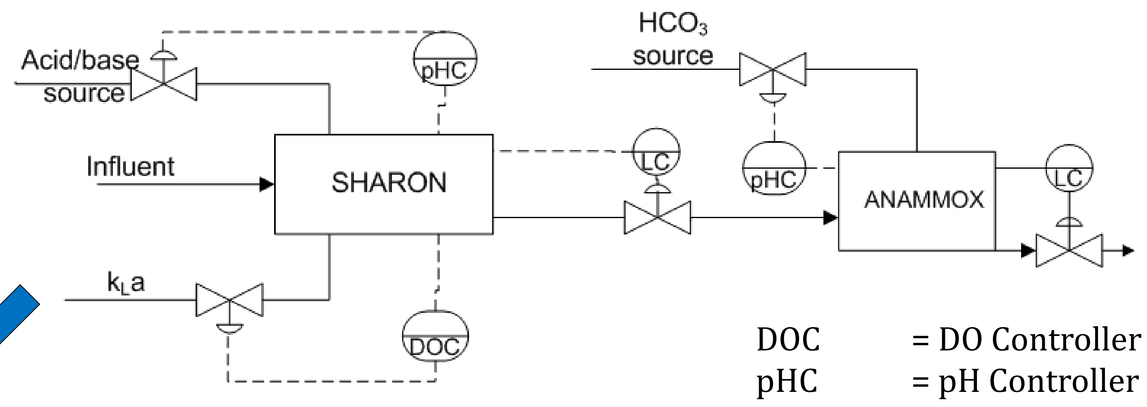
Bottom-up design

Selection of controlled variables based on disturbance impact

$$CLDG = \tilde{G}_{(s)} G^{-1}{}_{(s)} G_{d\,(s)}$$



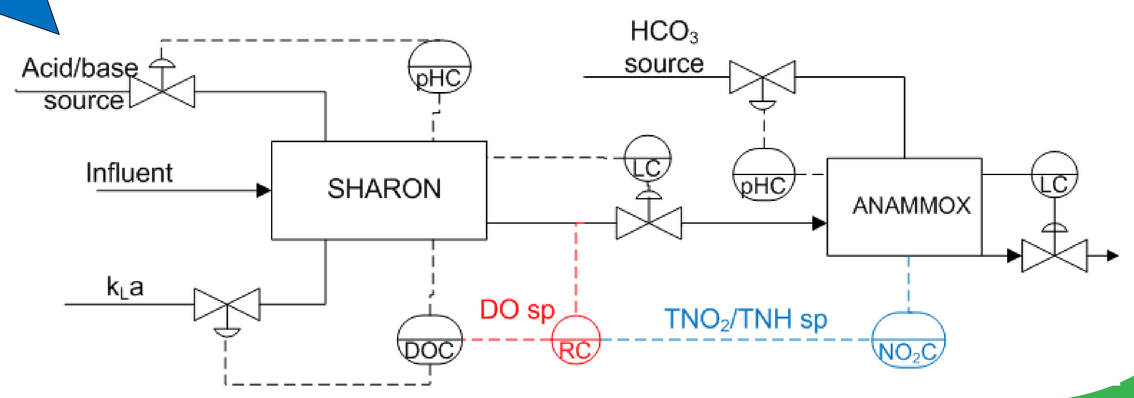
Regulatory layer



- To keep the $TNO_2/TNH = 1.3$
-Feedback from Anammox reactor

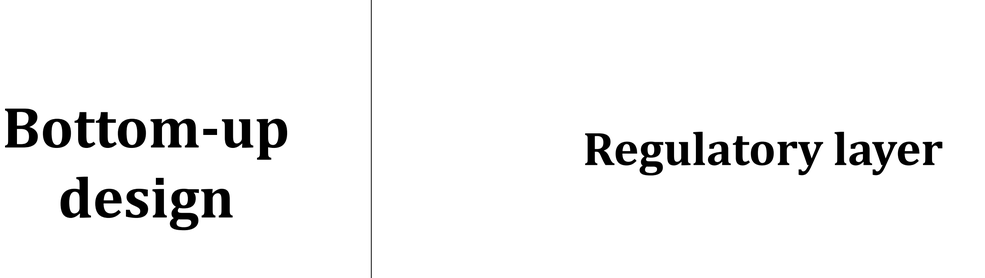
DOC = DO Controller
pHC = pH Controller
LC = Level Controller
RC = TNO_2/TNH Controller
NO_2C = NO_2 Controller

Supervisory layer

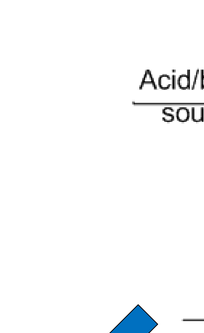


Evaluation

based on 15 days simulation



BSM2 anaerobic digester (Nopens *et al* 2010)



Structure	Nitrogen removal		DO loop	pH loop
Regulatory	**78.1%**	IAE (d)	0.45	1.79
		TV	336 d^{-1}	$2.25 \cdot 10^{-4}$ $m^3 d^{-1}$
Cascade	**85.7%**	IAE (d)	1.12	1.96
		TV	4.9510^3 d^{-1}	$5.90 \cdot 10^{-5}$ m^3 d^{-1}
Nested cascade	**91.4%**	IAE (d)	1.68	1.83
		TV	$3.73 \cdot 10^3$ d^{-1}	$5.30 \cdot 10^{-5}$ m^3 d^{-1}

Conclusions

- Three different control structures with incremental complexity were designed & evaluated for the SHARON – Anammox process
- A nested cascaded structure were found best in terms of rejecting disturbances and achieving the best nitrogen removal performance

Contact
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References:

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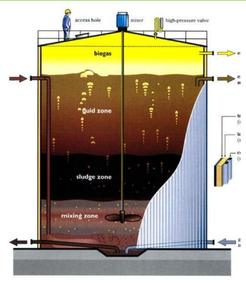

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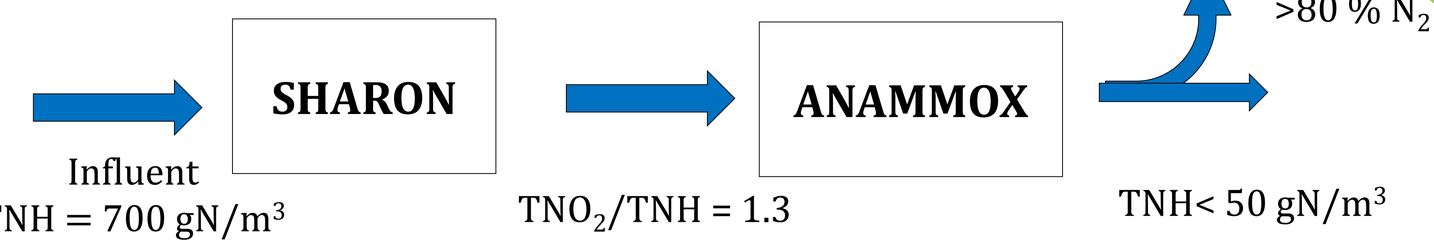

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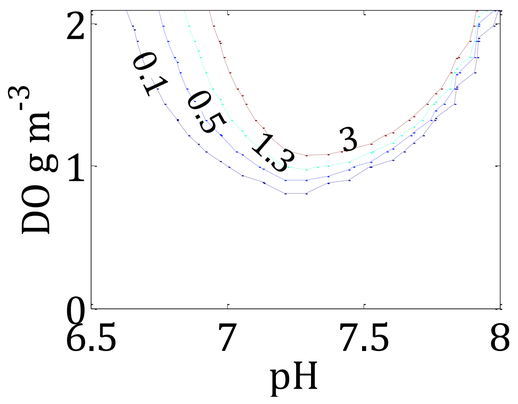

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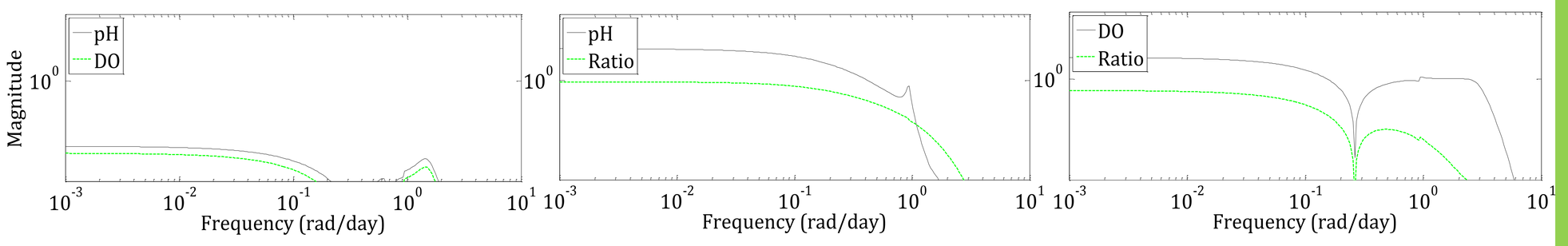

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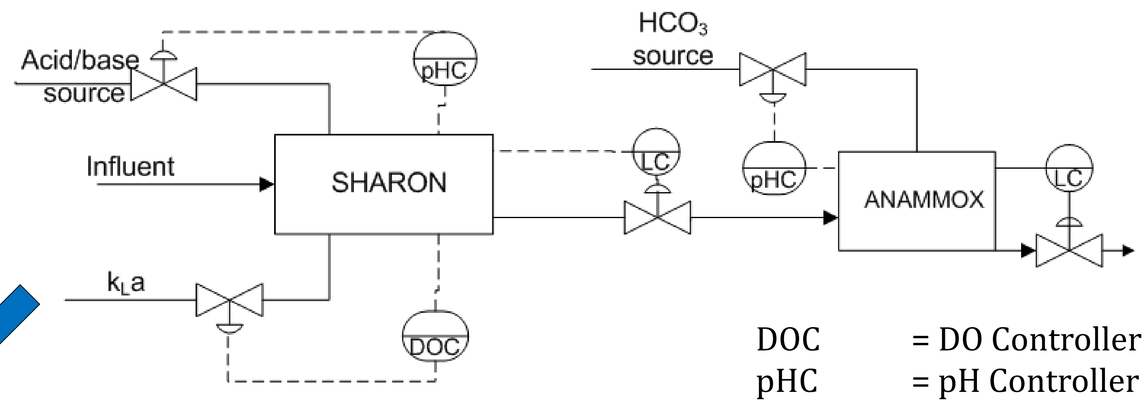

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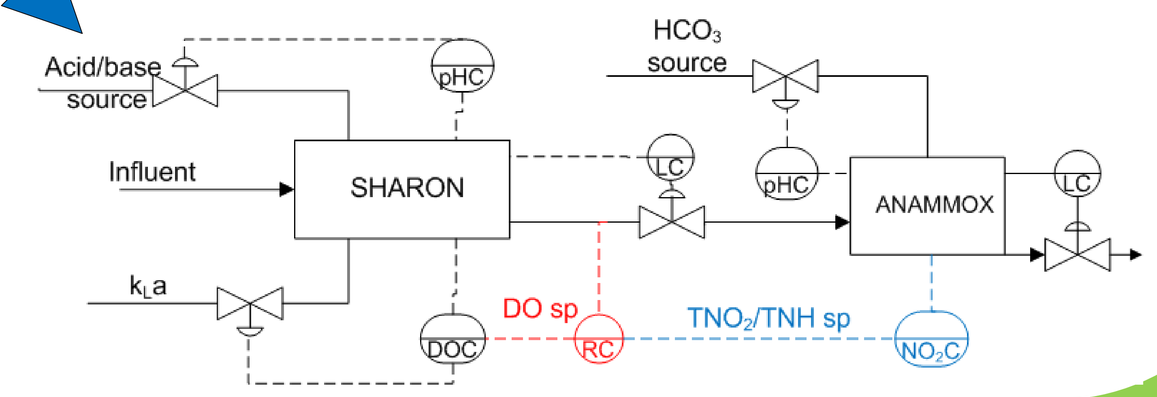

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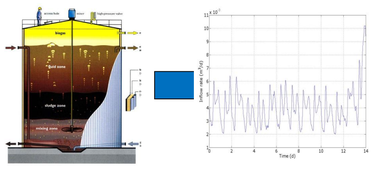

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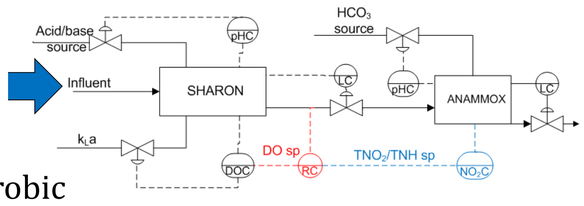

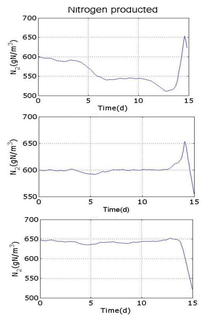

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